National Transportation Safety Board
Aviation Accident Final Report

Location:	Palmer, AK	**Accident Number:**	ANC17LA008
Date & Time:	11/25/2016, 1330 AKS	**Registration:**	N37PX
Aircraft:	AIRBORNE EXTREME LLC SQ-12	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	3 None
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The private pilot reported that, while in level cruise flight, the engine experienced a total loss of power; he then made a forced landing to a remote gravel bar. During the forced landing, the airplane sustained substantial damage to the left lift strut and fuselage. Following the forced landing, the pilot noticed that the 5-ampere fuel injector circuit breaker had opened.

A postaccident engine run at various idle power settings revealed no evidence of any preimpact mechanical anomalies with the airplane's engine or systems.

The airplane was equipped with an EFII electronic fuel injection and ignition system. A postaccident examination of the system revealed that the fuel injectors had been separated from the ignition power circuit and installed on their own dedicated circuit. The circuit was protected with one 5-ampere circuit breaker, with each individual fuel injector requiring up to 1.25 ampere of electrical current. The EFII installation manual requires one 10-ampere circuit breaker for the ignition circuit, which includes power leads for the ignition coil packs and the electronic fuel injectors. The company that installed the EFII harness provided correspondence from a previous EFII electronic fuel injection and ignition installation, where EFII had recommended that a 5-ampere circuit breaker be used if the fuel injectors were placed on their own dedicated circuit. The installation company stated that this guidance was applied to the accident airplane's installation.

Because the 5-ampere circuit breaker was installed, it is likely that the circuit breaker opened and resulted in a loss of electrical power to the electronic fuel injectors, which then resulted in a total loss of engine power.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The fuel injector manufacturer's inappropriate guidance to use a 5-ampere circuit breaker in place of the required 10-ampere circuit breaker on the fuel injector circuit, which resulted in the circuit breaker opening, a loss of electrical power to the electronic fuel injectors, and a subsequent total loss of engine power.

Findings

Aircraft	Fuel control electronic - Failure (Cause)
Personnel issues	Understanding/comprehension - Not specified (Cause)

Factual Information

On November 25, 2016, about 1330 Alaska standard time, a tailwheel-equipped Airborne Extreme LLC SQ12 airplane, N37PX, sustained substantial damage during a forced landing, following a loss of engine power near Palmer, Alaska. The airplane was registered to Airborne Extreme LLC and operated by the pilot as a visual flight rules flight under the provisions of 14 *Code of Federal Regulations* Part 91 when the accident occurred. The certificated private pilot and two passengers were not injured. Visual meteorological conditions prevailed, and no flight plan had been filed. The flight departed Jackfish Landing Airport (7AK4), Wasilla, Alaska at about 1250.

During a telephone conversation with the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) on November 25, the pilot reported that the he had departed for an afternoon flight with two family members up the Knik Glacier. About 40 minutes after departure, while in level cruise flight the engine lost all power. He made a forced landing to a remote gravel bar. During the forced landing, the airplane sustained substantial damage to the left lift strut and fuselage.

In the Pilot/Operator Aircraft Accident Report (NTSB Form 6120.1) submitted by the pilot, he indicated that following the forced landing he noticed that the 5-ampere fuel injector circuit breaker had popped.

The airplane was equipped with a 4 cylinder, Titan 409 angle valve series engine, and an EFII electronic fuel injection and ignition system.

On December 12, 2016 the engine, while still mounted on the accident airplane's airframe was operated under the direction of the NTSB IIC, along with the rest of the investigative team. The engine was not run at full power due to impact damage to the airframe and propeller sustained during the accident, but it was operated at various idle power settings while cycling through both engine control units (ECU) and fuel pumps. No anomalies were observed. Further investigation revealed that the fuel injectors had been separated from the ignition power circuit and installed on their own dedicated circuit which was protect with one 5-ampere circuit breaker. In addition, one 10-ampere circuit breaker supplied power to each individual ignition coil pack.

A review of the EFII installation manual indicates that one 10-ampere circuit breaker is required for the ignition power circuit on 4 cylinder engines. The single 10-ampere circuit breaker supplies 12-volt power to the two ignition coil packs and all four electronic fuel injectors. In addition, all wiring harnesses shipped by EFII have power wires bundled with a heat shrink label on them with the appropriate breaker requirement.

According to EFII, the most electrical current required by each individual fuel injector is about 1.25-ampere, with the potential for a 75% duty cycle.

In an email provided to the NTSB IIC, Aerotronics, Inc. stated that prior to working on the accident airplane, they installed an EFII electronic fuel injection and ignition system on

another airplane. That airplane owner had requested that the fuel injectors be separated from the ignition harness. The owner had contacted EFII and requested guidance on what size breaker would be appropriate for a dedicated fuel injector circuit. EFII responded in an email "If there is going to be a separate breaker for the injector power, I would make it 5A." (A copy of this email, along with comments from EFII regarding the provided guidance is available in the public docket for this accident.) Aerotronics also stated that they followed that guidance provided by EFII on both the previous installation and on the accident airplane installation.

The closest weather reporting facility was Palmer Municipal Airport, Palmer, Alaska, about 30 miles northwest of the accident site. At 1353, an Aviation Routine Weather Report (METAR) from Palmer Airport was reporting, in part: wind from 120 degrees at 3 knots; visibility, 10 statute miles; clouds and sky condition, few clouds at 7,000 feet, scattered clouds at 12,000 feet; temperature, 10 degrees F; dew point 9 degrees F; altimeter, 29.21 inHG.

ADDITIONAL INFORMATION

Following this accident, EFII began evaluating injector power setups with integral 7.5 ampere fusible links on each injector feed, in addition, to the 10-ampere required circuit breaker. This design would not only protect the ignition circuit, but would provide additional protection for each individual fuel injector. Additionally, this design would reduce the possibility of an electrical short on one fuel injector resulting in an open circuit, and a loss of power to all fuel injectors, and a subsequent total loss of engine power.

History of Flight

Enroute-cruise	Loss of engine power (total) (Defining event)
Landing	Off-field or emergency landing

Pilot Information

Certificate:	Private	**Age:**	37, Male
Airplane Rating(s):	Single-engine Land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without Waivers/Limitations	**Last FAA Medical Exam:**	11/26/2012
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	1275 hours (Total, all aircraft), 1275 hours (Total, this make and model), 1271 hours (Pilot In Command, all aircraft), 139 hours (Last 90 days, all aircraft), 42 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	AIRBORNE EXTREME LLC	**Registration:**	N37PX
Model/Series:	SQ-12 NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	2016	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental	**Serial Number:**	SQ12-002
Landing Gear Type:	Tailwheel	**Seats:**	3
Date/Type of Last Inspection:	02/13/2016, Annual	**Certified Max Gross Wt.:**	2000 lbs
Time Since Last Inspection:	162 Hours	**Engines:**	1 Reciprocating
Airframe Total Time:	162.3 Hours at time of accident	**Engine Manufacturer:**	Titan
ELT:	C126 installed, not activated	**Engine Model/Series:**	IOX-409-K7JBN
Registered Owner:	AIRBORNE EXTREME LLC	**Rated Power:**	220 hp
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	PAAQ	**Distance from Accident Site:**	30 Nautical Miles
Observation Time:	2253 UTC	**Direction from Accident Site:**	155°
Lowest Cloud Condition:	Few / 7000 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	Overcast / 20000 ft agl	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	120°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.21 inches Hg	**Temperature/Dew Point:**	-12°C / -13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Wasilla, AK (7AK4)	**Type of Flight Plan Filed:**	None
Destination:	Wasilla, AK (7AK4)	**Type of Clearance:**	None
Departure Time:	1250 AKS	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	61.191944, -148.686944 (est)

Administrative Information

Investigator In Charge (IIC):	David B Banning	**Report Date:**	09/10/2018
Additional Participating Persons:	Charles Strange; Federal Aviation Administration; Anchorage, AK Robert Paisley; EFII Protek Performance		
Publish Date:	09/10/2018		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=94447		